and arranged by a competent person, and that he would then offer it to the Academy for publication.

Professor Mac Cullagh made some remarks, of which the following is the substance, concerning the letter communicated by Mr. Lloyd at a former meeting (see Proceedings, p. 520).

The letter read by Mr. Lloyd at a late meeting of the Academy, was written by me immediately after the examination for Fellowships, which was held in Trinity College, in the year 1831. I had been a candidate on that occasion; and Dr. Bartholomew Lloyd, to whom the letter was addressed, had been one of the examiners. The letter contains, among other things, several theorems taken from a geometrical theory of Rotation, with which I had been previously occupied. Soon after it was written, I returned to that theory, for the purpose of improving it in one part where I felt it to be defective, and where, indeed, I experienced the chief difficulty; I mean the part which relates to finding the position of the body at any given time. The method given in my letter for doing this by quadratures, had occurred to me in 1829; but I was, of course, not satisfied with it, and I had in the interval made some attempts to find a method more elegant, and, as far as possible, really geometrical. In the autumn of 1831 I succeeded completely in this, and no further additions of any consequence were made to the theory. The position of the line OI within the body, at any given time, was found by an elliptic function of the first kind, the modulus and amplitude of which are given immediately by geometrical considerations; the modulus of the function being in fact the ratio of the two moduli of the cone which that line, stationary in space, describes within the body. This result was deduced from Theorems I. and II. of the letter. The cone reciprocal to that just mentioned was used to find the position of the body in space. This reciprocal cone,

carried about with the body, always touches the invariable plane; the side of contact, at any instant, being that which corresponds to OI, and which therefore lies in the plane passing through OI and the axis of rotation. The angle described in the invariable plane by the side of contact is the sum or difference of two angles, one of which is proportional to the time, and the other is the angle described by that side in the surface of the cone. As the latter angle is measured by the arc of a spherical conic, it followed, on comparing this result with the integral given by Legendre in his discussion of the question of rotation, that the arc of a spherical conic represents an elliptic function of the third kind with a circular parameter.

The curve described by the point I on the surface of the ellipsoid, is a spherical conic; and it now appears in what way the consideration of this mechanical question led to the study of the properties of cones and spherical conics. From theorems relating to centrifugal forces and principal axes of rotation, I was further led to consider systems of ellipsoids and hyperboloids having the foci of their principal sections the same; and then the focal curves presented themselves as the limits of these surfaces. The properties of the focal curves and of confocal surfaces occupied me, at intervals, in the year 1832; but in the latter part of that year my attention was diverted from these subjects, and it was not until 1834 that I began to think of writing down and publishing the results of my inquiries respecting them. In doing so, I wished to be able to assign a geometrical origin to the surfaces of the second order, the theory of these surfaces being intended to precede that of rotation; and in seeking for such an origin, I found the modular property. But not long after (in the summer of 1834) happening to look into a French scientific journal, I learned that M. Poinsot had just read to the Academy of Sciences of Paris a memoir in which he treated the question of rotation geometrically, by a method

substantially the same as mine. This caused me to give up the design of writing on that subject; and, my thoughts then turning to the theory of light, the subject of surfaces of the second order was also dropped.

Another form of Theorem I. is given by the property of reciprocal ellipsoids. If a second ellipsoid be constructed, having its centre at O, and its semiaxes coincident with, and inversely proportional to those of the first, and if this ellipsoid be touched by a plane parallel to the invariable plane, it is obvious, from the relations of reciprocal ellipsoids, that the tangent plane will be fixed in space, and that the right line which joins the point of contact with the point O, will always be the axis of rotation, and will be proportional to the angular velocity. This form of the theorem, though not mentioned in the letter, was nevertheless employed in my theory of rotation. It is the form given by M. Poinsot, who uses only the second ellipsoid; and it has the advantage of determining geometrically (as M. Poinsot has remarked) the successive positions of the body in space, independently of the consideration of time; for the ellipsoid evidently *rolls* upon the fixed plane which it always touches. This advantage, however, though evident when stated, I do not recollect that I had distinctly perceived.

The theorem mentioned in my letter, for finding the moment of the centrifugal forces, is the same (making allowance for the difference of the ellipsoids) with one given by M. Poinsot, which he speaks of as "a simple and remarkable theorem, containing in itself the whole theory of the rotation of bodies;" and of which he further observes, as I have done, that "translated into analysis, it gives immediately the three elegant equations which are due to Euler, and which are usually demonstrated by long circuits of analysis." It was, in fact, from this theorem, by means of the principle of the composition and resolution of rotatory motions, that my theory, as well as that of M. Poinsot, was deduced. I may

add, that I also employed M. Poinsot's beautiful theory of *couples*, which has introduced so much clearness into the fundamental doctrines of mechanics.

Mr. G. Wilkinson read a paper on the existence of the pointed arch in the early buildings of Ireland, prior to the introduction of Gothic architecture.

Mr. Petrie offered some remarks on Mr. Wilkinson's communication.

Dr. Allman noticed the occurrence in Ireland of Fredericella Sultana, and entered into certain details of its zoological and anatomical characters. This zoophyte has been very imperfectly described, and is moreover burthened with a discordant synonomy which has involved its history in no small obscurity. The difficulty which is thus necessarily connected with the attempt to determine the true Fredericella Sultana, Dr. Allman endeavoured to remove, by reducing to some sort of order the mass of synonymes in which it is involved. It would appear to be the *Tubularia Sultana* of Blumenbach, its original discoverer; the *Plumatella Gelatinosa* of Dr. Fleming; the *Plumatella Sultana* of Sir J. G. Dalyell; and the *Fredericella Sultana* of Gervais. It would appear also that the zoophyte described by Mr. Varley, in a late number of the London Physiological Journal, is the same as the present.

By some singular oversight, Dr. Fleming, in the description of his Plumatella Gelatinosa, refers to the Tubularia Gelatinosa of Pallas, described in the "Elenchus Zoophytarum." The Tubularia Gelatinosa of the Elenchus, however, is quite a different animal; it belongs to the group with crescentic disks, and is identical with the free variation of *Plumatella repens*.

The author, in entering into the details of its anatomical structure, drew attention to the high ascidiform type which